Interactions Between Visual Working Memory, Attention, and Color Categories: a Pupillometry Study

Thomas Wilschut
t.j.wilschut@rug.nl
Department of Behavioral and Cognitive Neurosciences
University of Groningen

Sebastiaan Mathôt
s.mathot@rug.nl
Department of Experimental Psychology
University of Groningen

BACKGROUND

In this study, we combine two recent findings:

1. Visual working memory (VWM) for color is biased by **categories**: colors are remembered as more prototypical to their category (Bae et al., 2015)

2. Two recent studies succeeded in inferring the *visual salience* of a stimulus from pupil size:

- Binda et al. (2015) found a stronger *early pupil constriction* for **attended** compared to unattended stimuli
- Olmos-Solis et al. (2018) found that stimuli **that match the color of an item maintained in VWM** result in a *longer pupil constriction* compared to non-matching stimuli

AIMS

Here, we examine color-category effects on VWM using pupillometry and visual salience. The aims of the study are twofold:

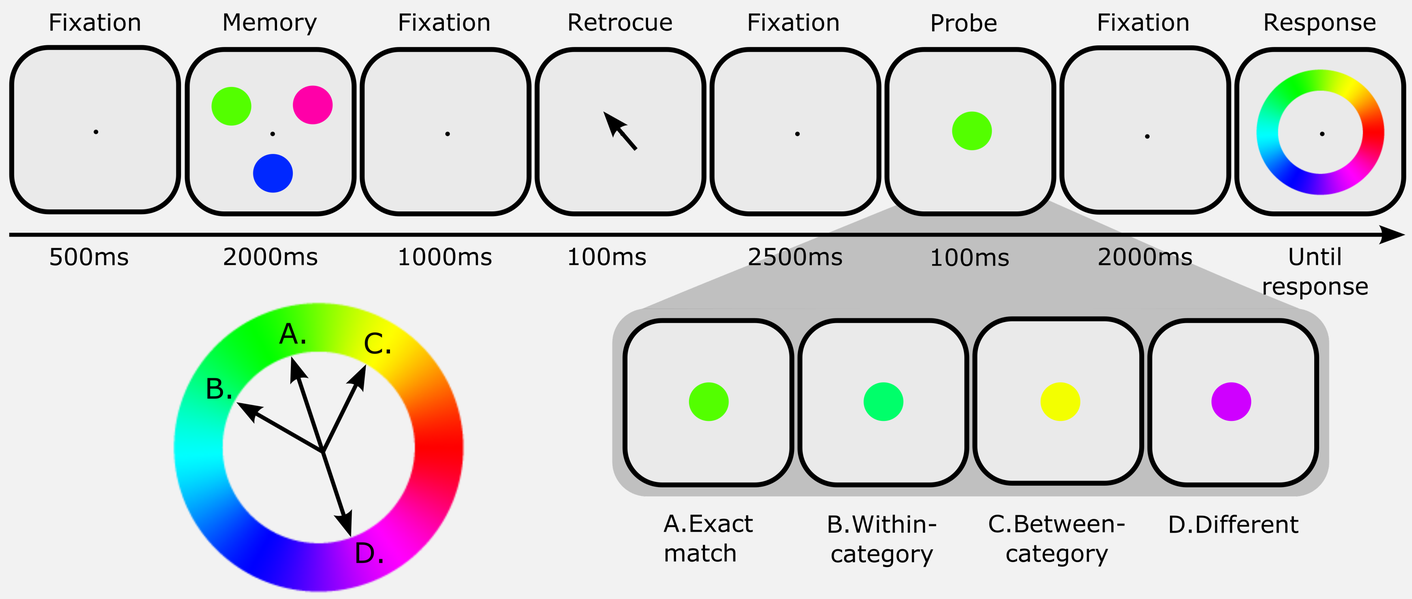
1. Replicate the results by Binda et al. (2015) and Olmos-Solis et al. (2018). How do pupil responses reflect the visual salience of a stimulus?

2. Examine how color categories modulate (a) visual saliency reflected by pupil responses and (b) behavioral color reproductions

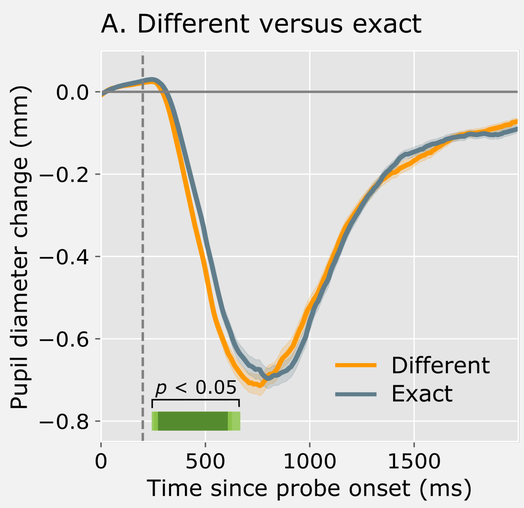
METHODS

Participants remembered a color. During the retention interval, a probe was presented, which could be:

A. Exact match: an **exact match** of memory item
B. Within-category: slightly different from, but in the **same color category** as the memory item
C. Between-category: equally different from, but in **another color category** as the memory item
D. Different: **opposite** to the memory item

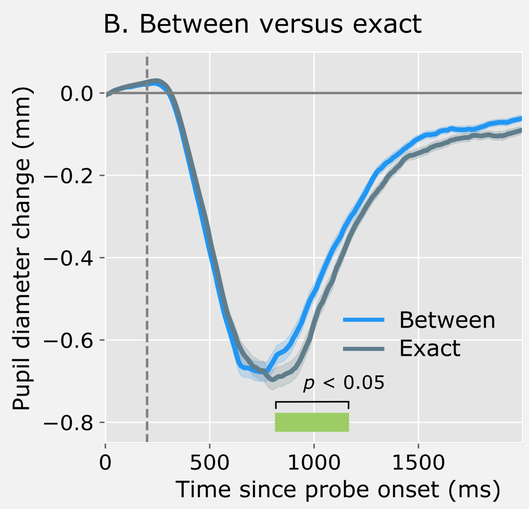


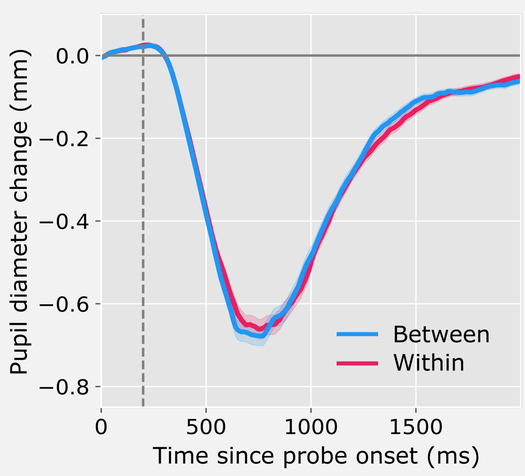
RESULTS



Pupil responses show a *stronger initial constriction to new (Different) stimuli*

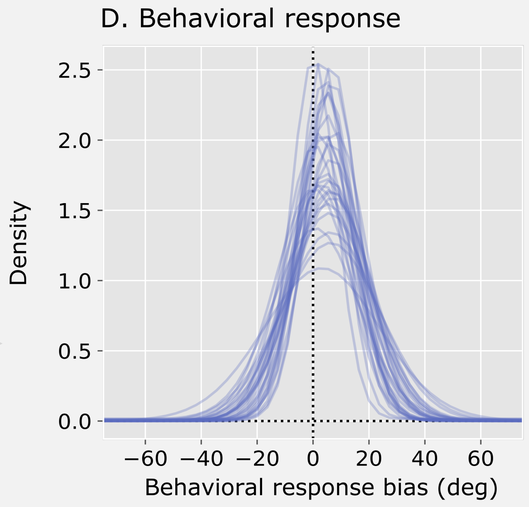
and a more *prolonged constriction to stimuli that match the content of VWM*





There is no effect of color category on pupil responses

Behavioral color reproductions are systematically drawn towards color category centres



CONCLUSIONS

Visual salience and pupil size

1. Stronger initial constriction for new stimuli may reflect *adaptation effects*

2. Longer constriction for memory matching stimuli reflects *memory driven capture effects*

Adaptation and memory driven capture *together determine the visual salience of the stimulus* and affect early and late components of the pupil response, respectively

Color category effects

Color categories do not affect memory-driven capture as measured through pupil constriction, even though behavioral responses are biased by color categories in the same task

While categorical biases are an important characteristic of visual perception and VWM, they may not affect all levels of visual processing

REFERENCES

Bae, G.-Y., Olkkonen, M., Allred, S. R., & Flombaum, J. I. (2015). Why some colors appear more memorable than others: A model combining categories and particulars in color working memory. Journal of Experimental Psychology: General, 144(4), 744. DOI: https://doi.org/10.1037/xge0000076

Binda, P., & Murray, S. O. (2015). Spatial attention increases the pupillary response to light changes. Journal of vision, 15(2), 1–1. DOI: https://doi.org/10.1167/15.2.1

Olmos-Solis, K., van Loon, A. M., & Olivers, C. N. (2018). Pupil dilation reflects task relevance prior to search. Journal of cognition, 1(1). DOI https://doi.org/10.5334/joc.12:

contact: t.j.wilschut@rug.nl

data, analyses and preregistration: https://osf.io/qksfh/